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### Switching It Up: Bilingual Education Fostering Cognitive Flexibility and Math Achievement

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Dotan, Lital, "Switching It Up: Bilingual Education Fostering Cognitive Flexibility and Math Achievement" (2020). *Academic Spree Day and Fall Fest*. 18.

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# Switching It Up: Bilingual Education Fostering Cognitive Flexibility and Math Achievement

Lital Dotan, Sangmi Park, Alena G. Esposito



## Introduction

- ❖ Math achievement in early elementary school is pivotal for overall academic achievement. *Lee, J. (2012), Siegler, R. S. (2012)*
  - ❖ Many students begin to struggle with mathematical concepts around late elementary school due to the increasing complexity and abstract density. *Matthews, J. S. (2018)*
  - ❖ Cognitive function is associated with math achievement. Code switching is a cognitive process that helps people with comprehension with concepts that use different areas of the brain—for example images and numbers *Matthews, J. S. (2018), Duval, R. (2006)*
  - ❖ Bilingual education promotes cognitive flexibility as people use code-switching to switch between languages. *Bialystok 2001; Christoffels, 2015*
- Research question:**
- ❖ Does the cognitive flexibility that is gained through bilingual education translate into math achievement?
  - ❖ Does the cognitive flexibility that is gained through bilingualism translate into math achievement

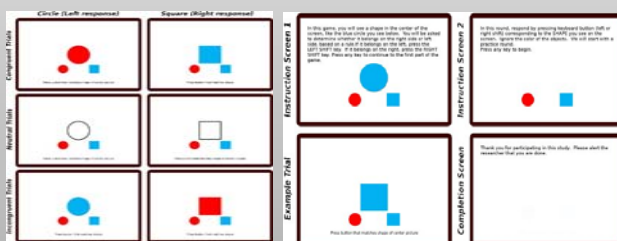
## Method

- ❖ **The Woodcock-Muñoz Language Survey** was used both in English and in Spanish in order to test the children's proficiency in their language.



- ❖ **The Bivalent Shape Task**

The test is administered on a computer and it measures the child's ability to inhibit incorrect but automatic response.



- ❖ **Math Scores**

- Math End Of Grade (EOG) exam scores- 4<sup>TH</sup> grade standardized math test

## Results

*Frequencies of Two Bilingual Measures.*

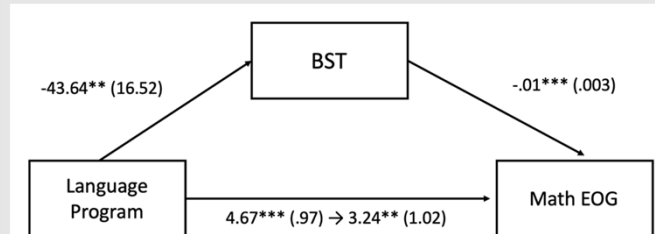
	Traditional Education program	Dual-language program
Monolingual	171	76
Bilingual	38	63

Means (Standard Deviations) for BST, and Math EOG Separated by Education

Program and Bilingualism

	Education Program		Bilingualism	
	Traditional	Dual-language	Monolingual	Bilingual
BST	934.28 (138.89) n = 258	890.64 (145.28) n = 101	922.06 (140.23) n = 202	917.58 (144.11) n = 134
Math EOG	445.04 (9.31) n = 352	449.71 (7.69) n = 113	446.45 (9.05) n = 207	447.59 (8.42) n = 139

Mediation effect of BST in the relation between Language Program and Math EOG



Two mediation models were examined.

- ❖ The first examined whether Cognitive Flexibility mediated the relation between Language Program and Math Performance.
  - ❖ Language Program predicted Math Performance.
  - ❖ Language Program predicted Cognitive Flexibility.
  - ❖ Cognitive Flexibility significantly mediated the relation between Language Program and Math Performance such that those in the dual-language education program showed better cognitive flexibility that explained the higher math scores.
- ❖ The second examined whether Cognitive Flexibility mediated the relation between Bilingualism and Math Performance.
  - ❖ Bilingualism did not significantly predict Math Performance or Cognitive Flexibility; thus, mediation was not examined.

## Discussion

- Not all contexts of bilingualism are sufficient to significantly affect executive function.
- Learning and engaging in multiple languages within the environment of dual-language classrooms develops the students' cognitive flexibility.
- Future studies should include how bilingual education promotes diversity and if this would affect the achievement of minority students.
- These results supported that cognitive flexibility gained through bilingual education translates into math achievement.

## Key references

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